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H4F FAAE FD12X FD2B FD83B
U1S S1820 S2103 S2104 S2106 S2184 S2195 S2222

(56) Documents Cited
GB 2224358 A **GB 2207401 A** **GB 2081484 A**
EP 0462464 A2 **WO 88/09023 A1** **WO 86/04869 A1**
US 4638289 A **US 4281354 A** **US 3781824 A**

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UK CL (Edition K) **G1N NAAJ , G4N NHVS , H4F FAA**
INT CL[5] **G07C 5/08**
ONLINE DATABASE: WPI

(54) **Vehicle accident prevention and recording system**

(57) The system monitors and records the operation of the vehicle, driving status and the outside environment safeguards the vehicle against traffic accidents by warning the driver in the nick of time and correcting the operation of the vehicle automatically. After an accident occurs, the ins and outs of the occurrence, by means of a computer device, can be retrieved, played back and analysed based on the aforesaid recorded information. The record can be used in the drivers' training courses, or as driving reference; be of benefit to the insured and the insurance companies; be used as reference to assist the official judgment of this accident. Most of all, due to the function of automatic monitoring and recording, this device will give alarms as the accident occurs which can prevent its following vehicles from colliding with each other; also, the traffic lanes, after the accident occurs, can be restored to the original condition quickly, since the device has already recorded most of the required information which can reduce the argument among the drivers involved and help the patrolman handle this incident quickly.

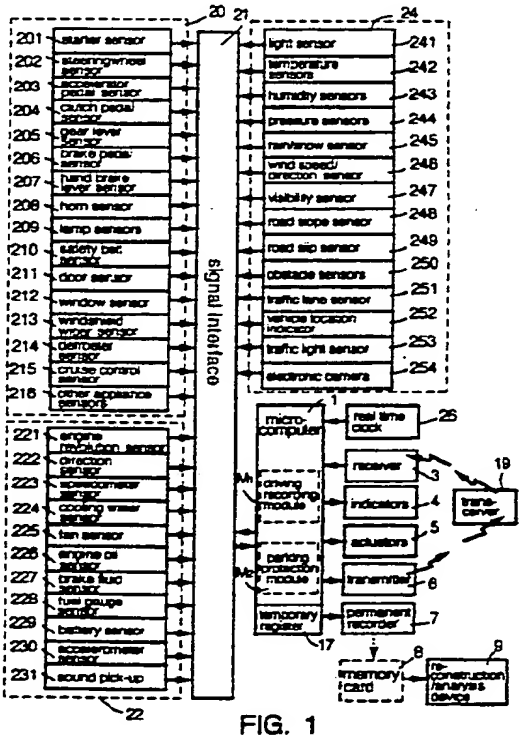

FIG. 1

GB 2 268 608 A

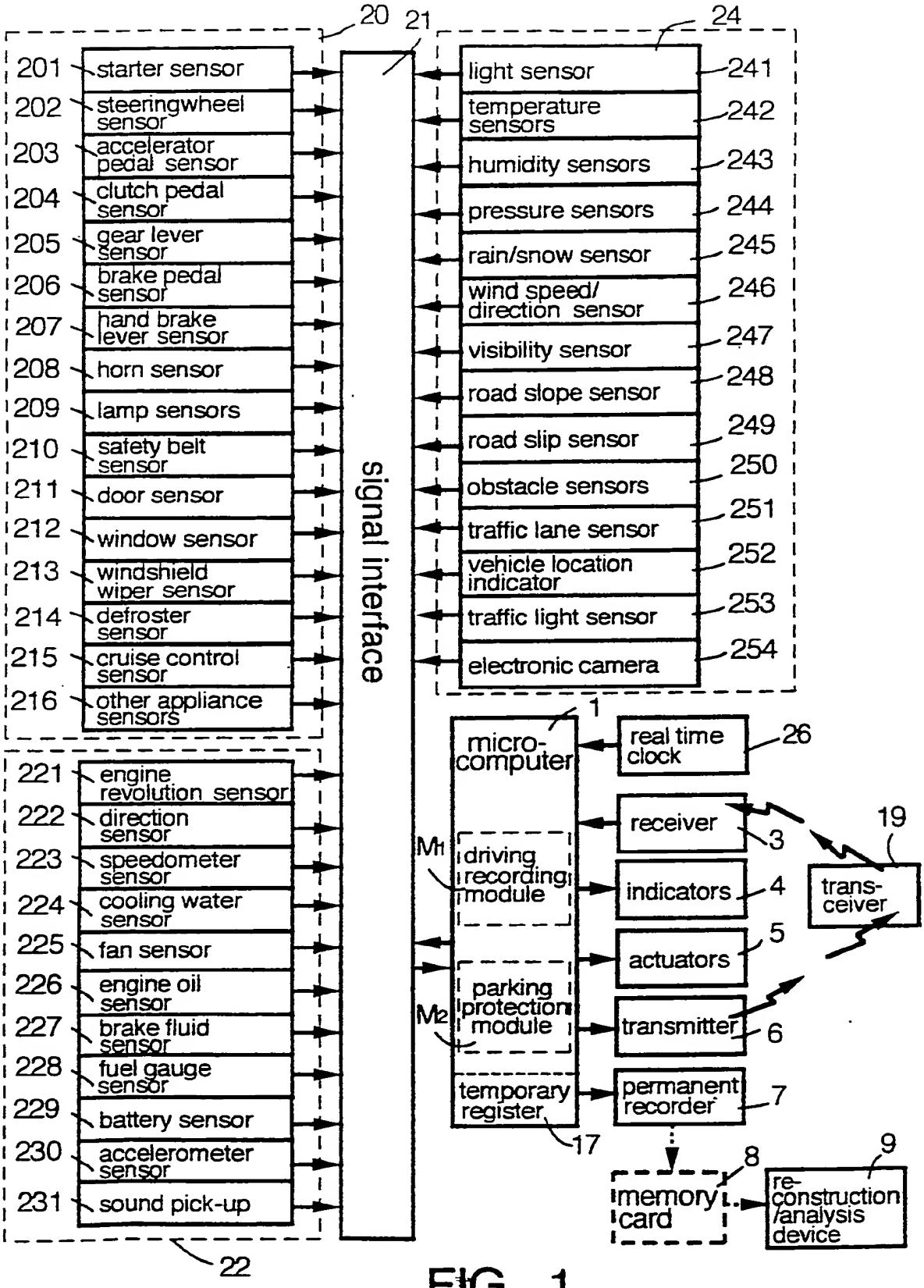
20
21
24
201 starter sensor
202 steeringwheel sensor
203 accelerator pedal sensor
204 clutch pedal sensor
205 gear lever sensor
206 brake pedal sensor
207 hand brake lever sensor
208 horn sensor
209 lamp sensors
210 safety belt sensor
211 door sensor
212 window sensor
213 windshield wiper sensor
214 defroster sensor
215 cruise control sensor
216 other appliance sensors
signal interface
221 engine revolution sensor
222 direction sensor
223 speedometer sensor
224 cooling water sensor
225 fan sensor
226 engine oil sensor
227 brake fluid sensor
228 fuel gauge sensor
229 battery sensor
230 accelerometer sensor
231 sound pick-up
22
light sensor 241
temperature sensors 242
humidity sensors 243
pressure sensors 244
rain/snow sensor 245
wind speed/ direction sensor 246
visibility sensor 247
road slope sensor 248
road slip sensor 249
obstacle sensors 250
traffic lane sensor 251
vehicle location indicator 252
traffic light sensor 253
electronic camera 254
1
micro-computer
real time clock 26
receiver 3
19
trans-ceiver
M1
driving recording module
indicators 4
actuators 5
M2
parking protection module
transmitter 6
temporary register 17
permanent recorder 7
8
memory card
9
re-construction /analysis device

FIG. 1

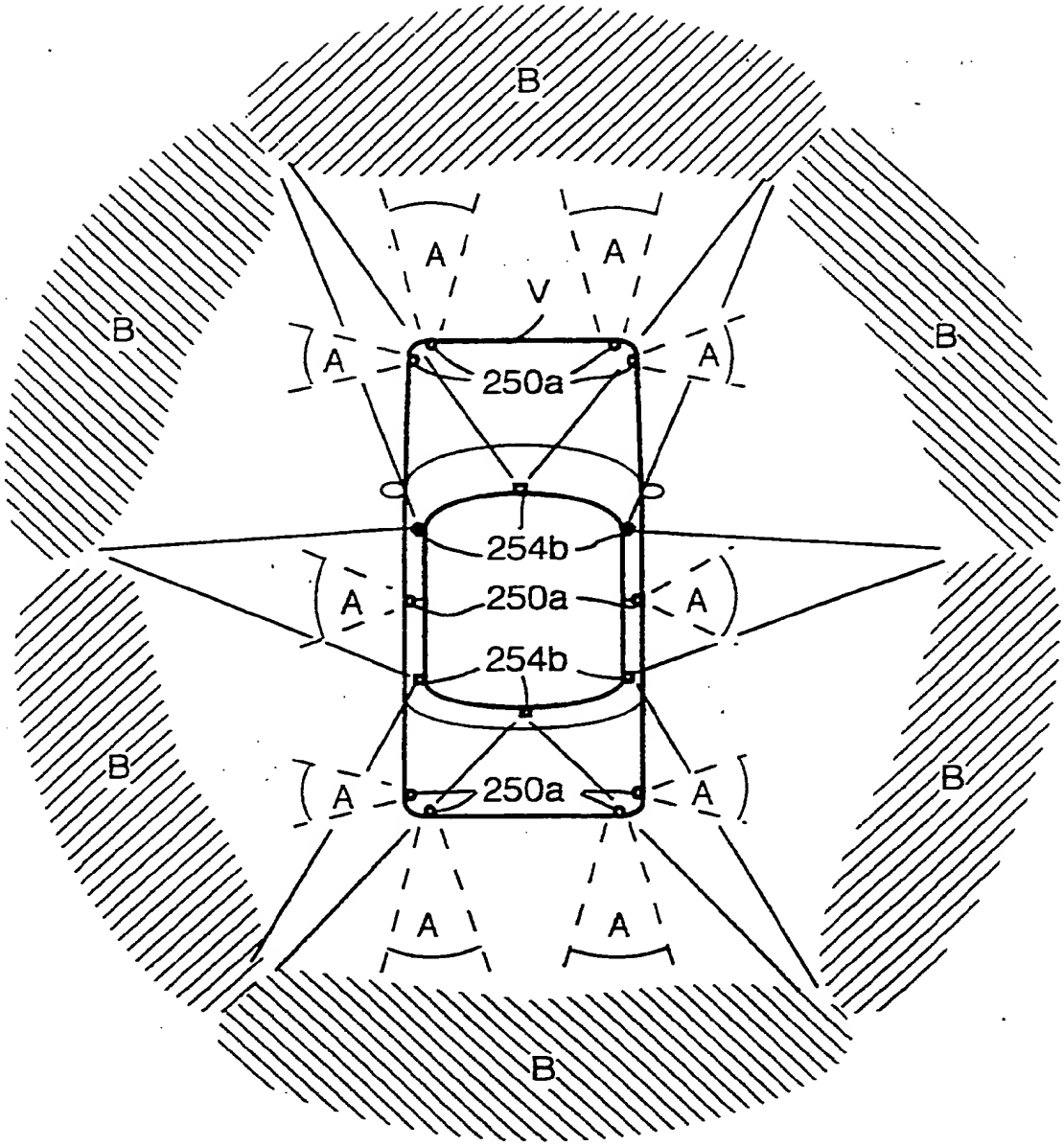

FIG. 2

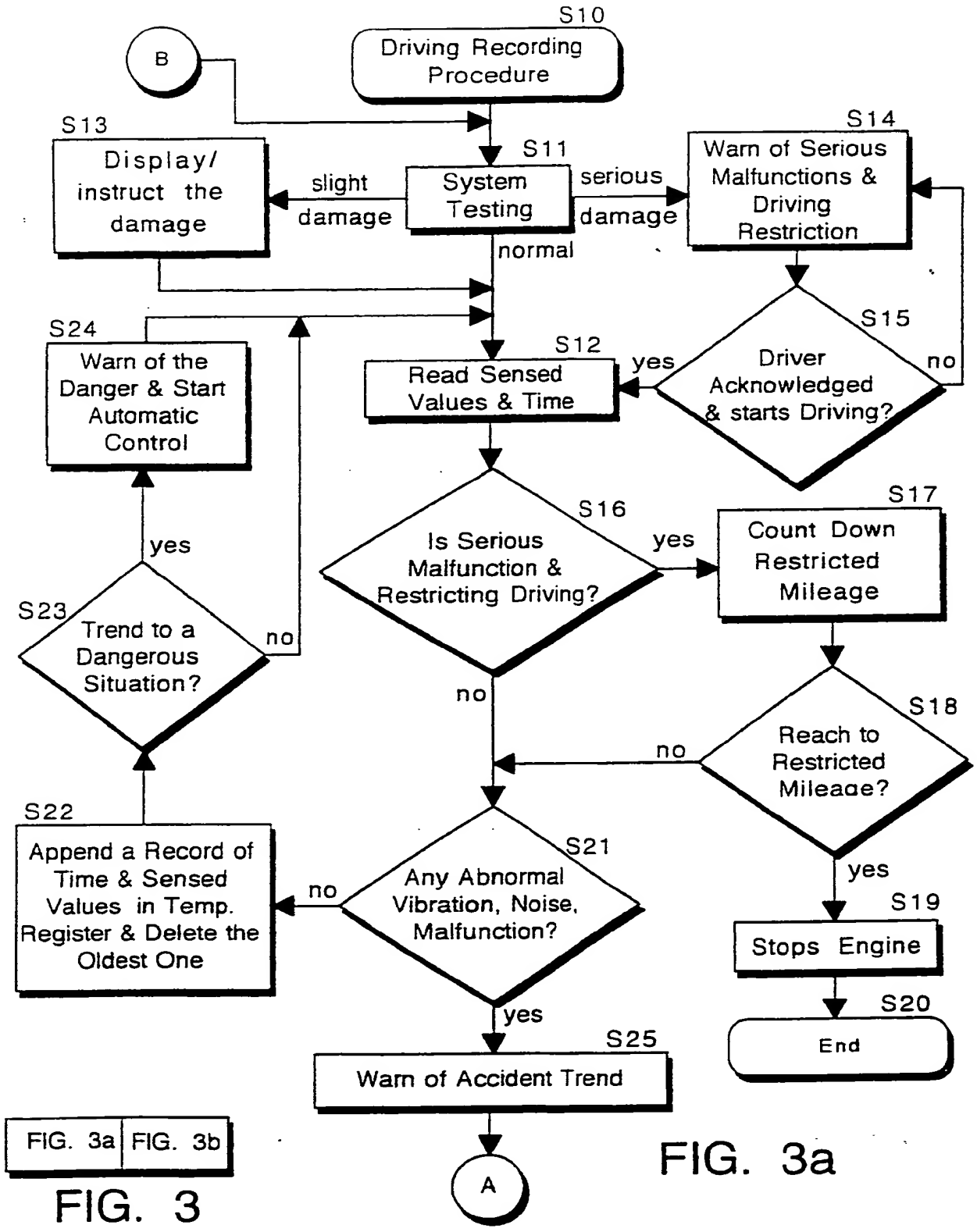

FIG. 3a

FIG. 3a | FIG. 3b

FIG. 3

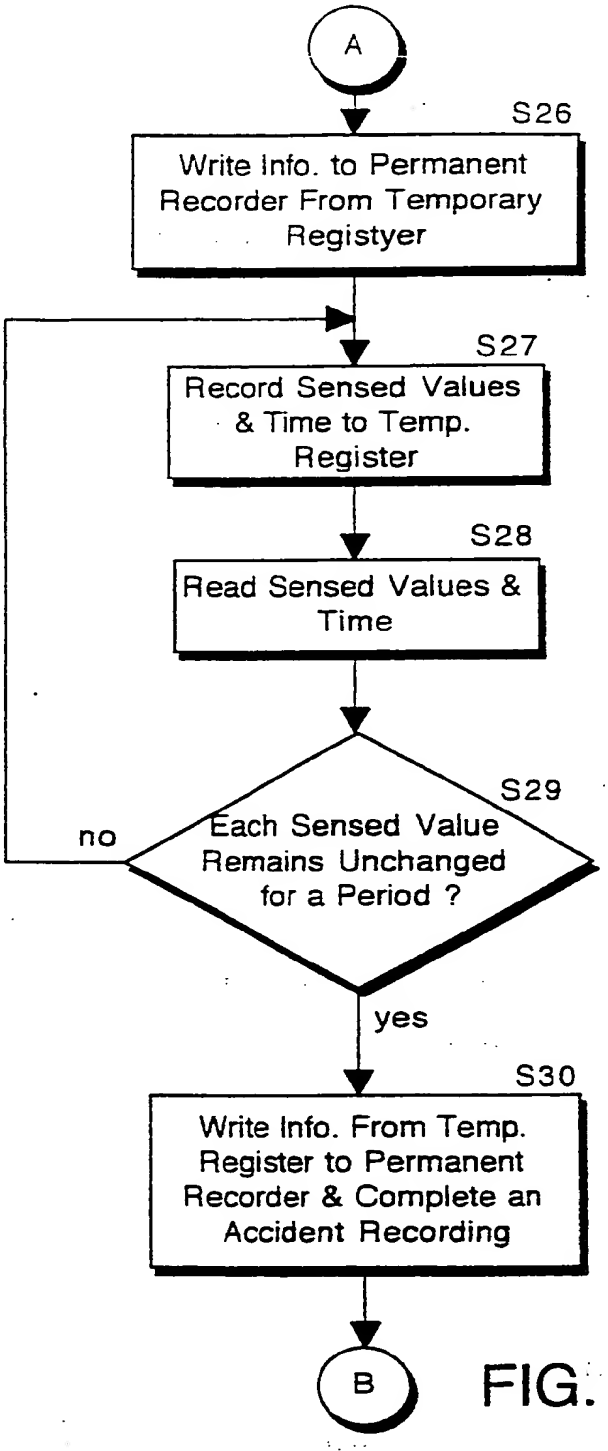
A
S26
Write Info. to Permanent Recorder From Temporary Registyer
S27
Record Sensed Values & Time to Temp. Register
S28
Read Sensed Values & Time
S29
Each Sensed Value Remains Unchanged for a Period ?
no
yes
S30
Write Info. From Temp. Register to Permanent Recorder & Complete an Accident Recording
B

FIG. 3b

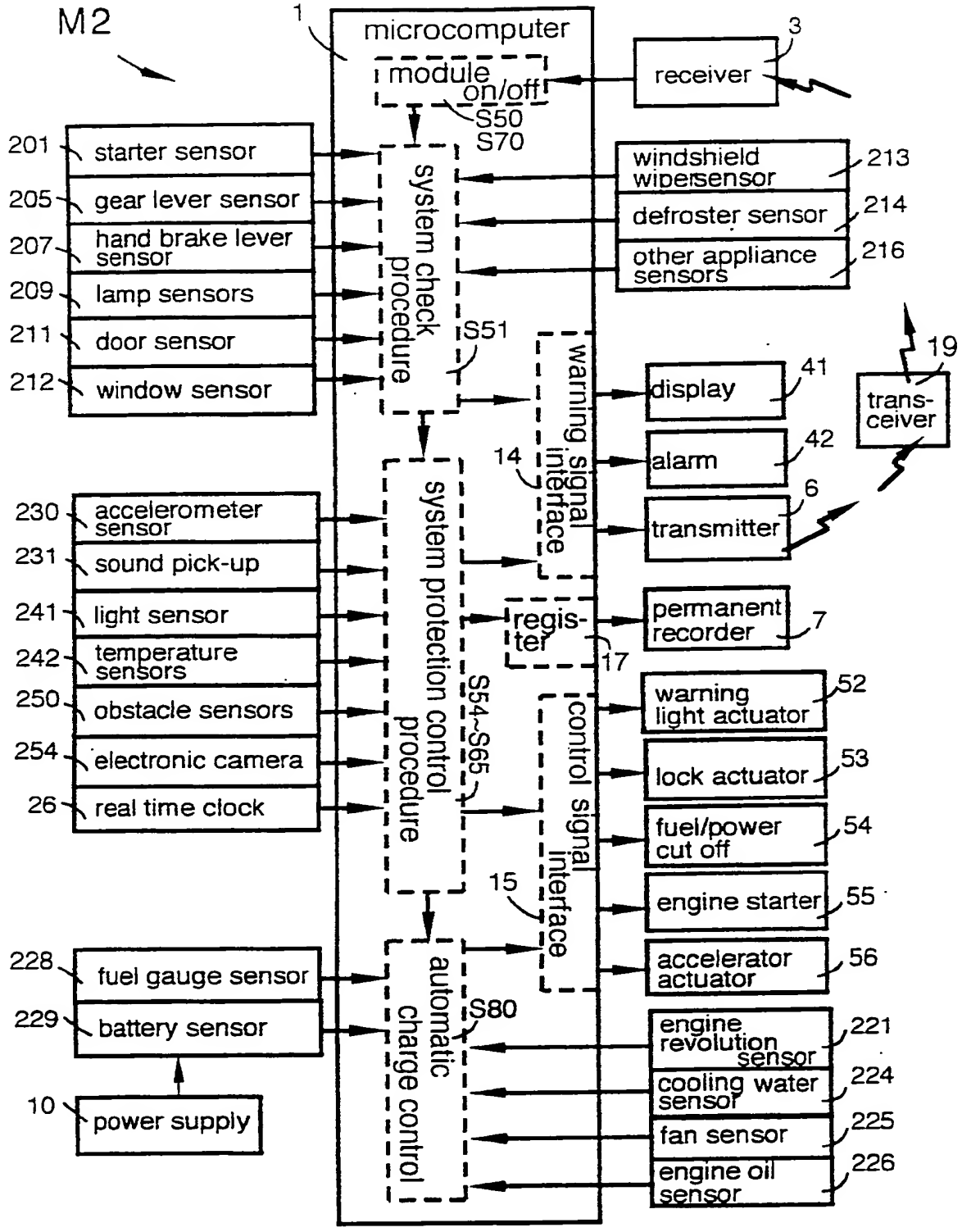
M2
1
microcomputer
module on/off
S50
S70
receiver
3
201 starter sensor
205 gear lever sensor
207 hand brake lever sensor
209 lamp sensors
211 door sensor
212 window sensor
system check procedure
S51
windshield wipersensor 213
defroster sensor 214
other appliance sensors 216
warning signal interface
14
display 41
alarm 42
transmitter 6
19
trans-ceiver
230 accelerometer sensor
231 sound pick-up
241 light sensor
242 temperature sensors
250 obstacle sensors
254 electronic camera
26 real time clock
system protection control procedure
S54~S65
regis-ter 17
permanent recorder 7
warning light actuator 52
lock actuator 53
fuel/power cut off 54
engine starter 55
accelerator actuator 56
control signal interface
15
228 fuel gauge sensor
229 battery sensor
automatic charge control
S80
engine revolution sensor 221
cooling water sensor 224
fan sensor 225
engine oil sensor 226
10 power supply

FIG. 4

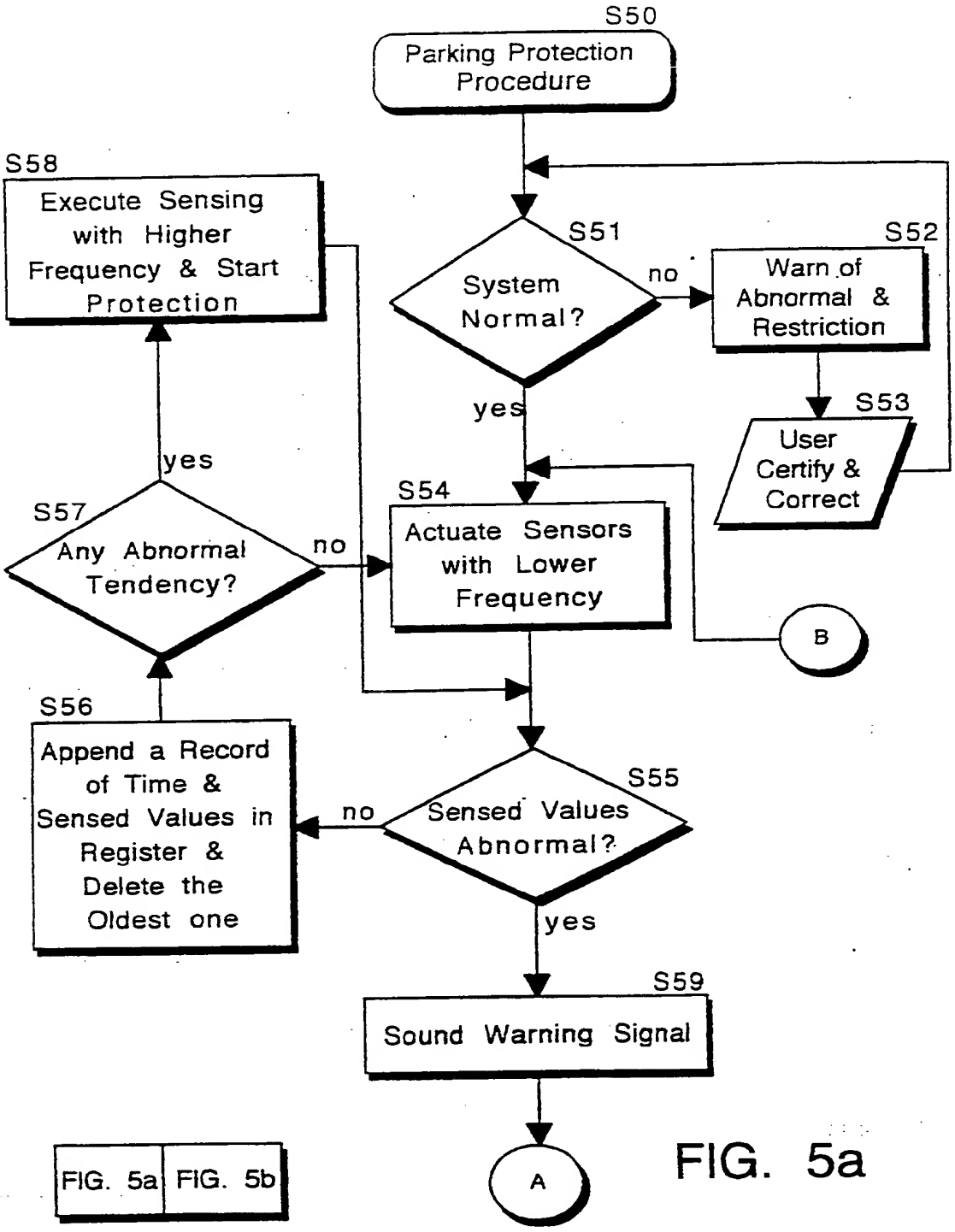

FIG. 5a

FIG. 5a	FIG. 5b

FIG. 5

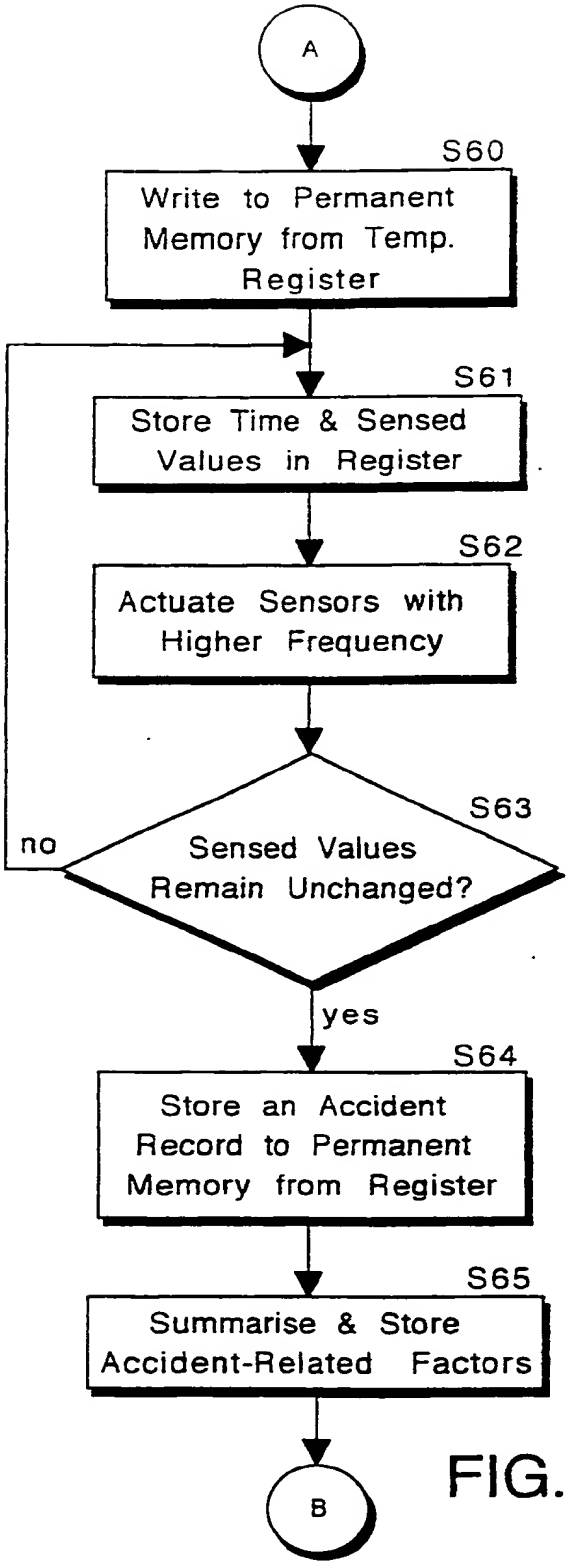
A
S60
Write to Permanent Memory from Temp. Register
S61
Store Time & Sensed Values in Register
S62
Actuate Sensors with Higher Frequency
S63
Sensed Values Remain Unchanged?
no
yes
S64
Store an Accident Record to Permanent Memory from Register
S65
Summarise & Store Accident-Related Factors
B

FIG. 5b

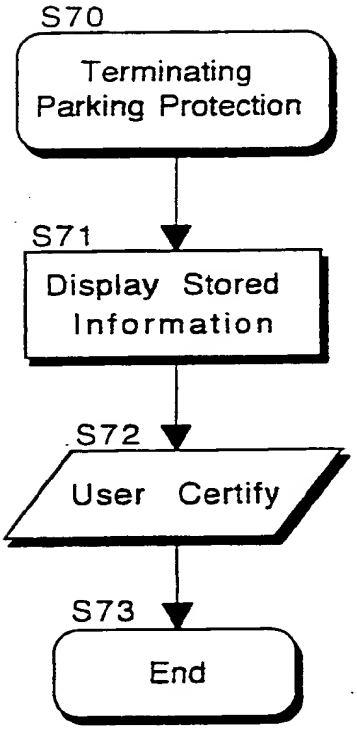
S70
Terminating Parking Protection
S71
Display Stored Information
S72
User Certify
S73
End

FIG. 6

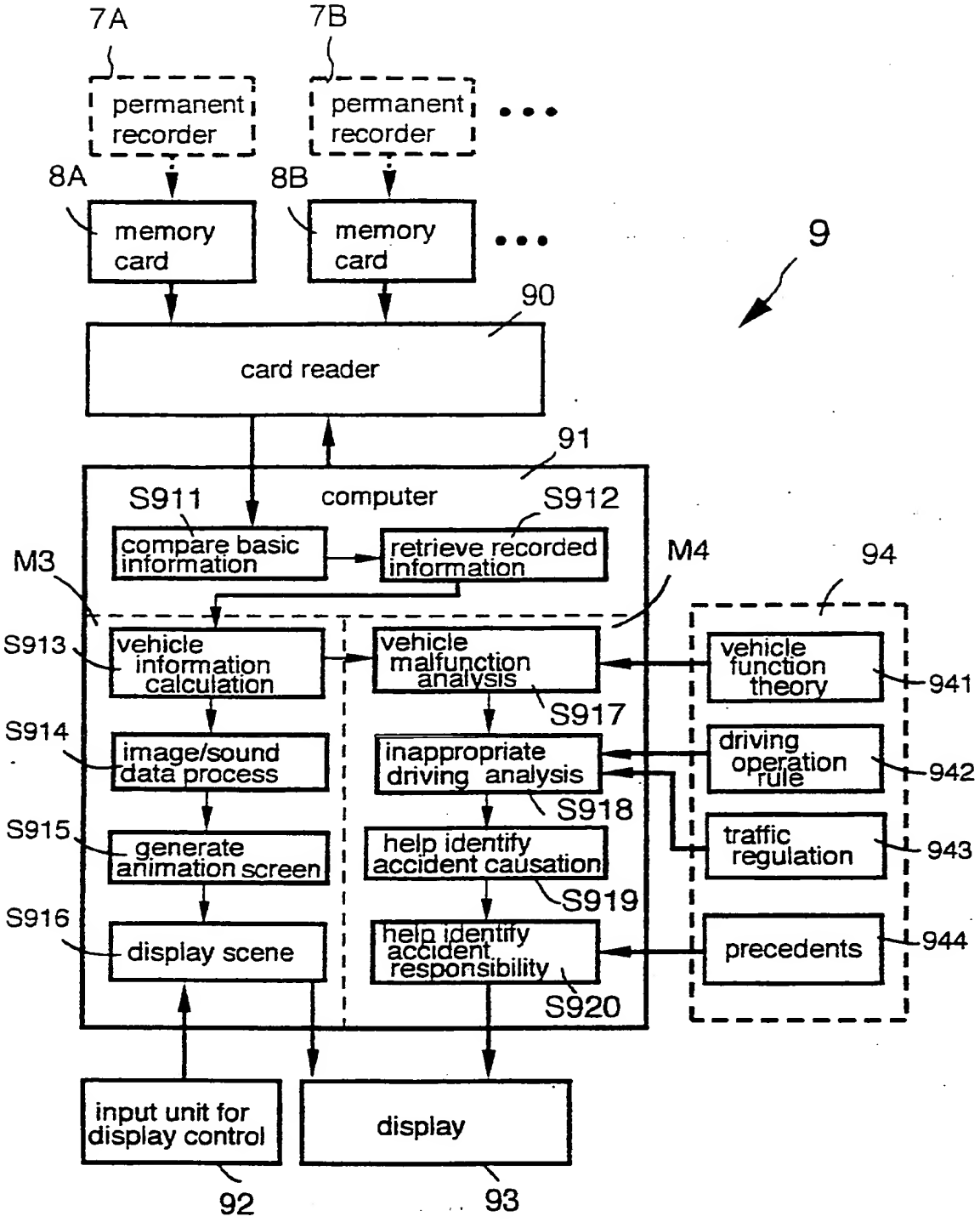
7A
7B
permanent recorder
permanent recorder
8A
8B
memory card
memory card
9
90
card reader
91
computer
S911
compare basic information
S912
retrieve recorded information
M3
M4
94
S913
vehicle information calculation
vehicle malfunction analysis
vehicle function theory
941
S917
S914
image/sound data process
inappropriate driving analysis
driving operation rule
942
S918
S915
generate animation screen
help identify accident causation
traffic regulation
943
S919
S916
display scene
help identify accident responsibility
precedents
944
S920
input unit for display control
display
92
93

FIG. 7

ACCIDENT PREVENTION, RECORDING, RETRIEVING AND ANALYSIS DEVICE FOR VEHICLE

This invention relates to a device, installed in a vehicle, which is able to prevent a vehicle accident beforehand, record an accident, and provide data for accident reconstruction and analysis.

Most of the factors critical to the cause of an accident, generally speaking, are attributed to: the status of the driver (drowsy, drunken, driving in high speed, taking a zigzag course, or violating traffic signs), the functions of the vehicles (such as malfunctions of components or poor design of vehicle), environmental conditions, roadway conditions (poor design or insufficient facilities), and traffic conditions; wherein, most can be avoided if the driver is warned of a danger timely or prior, and the damage/casualty caused by the accidents can be diminished. To cite one example, a vehicle turning into another direction in high speed is apt to capsize; the vehicle, if equipped with a device which monitors driving status of the vehicle, can send warning signals to the driver to reduce the speed properly, thus, may safeguard the vehicle from accident. However, there was no such device which monitors, warns of, and controls the driving status.

Moreover, when an accident happened, it is required to close off the area and wait for the patrolmen or the expert examiners to record and map. In consequence, the accident can not be handled immediately, this may either cause delay to save the wounded, obstruct traffic flow or even cause some following vehicles to collide with each other. Besides, the examiners record all the information on the spot, such as the relative

positions of the vehicles, traces of the brake, and statements of the persons involved as well as the witnesses; it is, however, sometimes hard to expose the truth due to those fragmental remarks. As to the insurance companies, they may overpay the compensation and distribute it to the insured. Moreover, since the actual situation is hard to be obtained, it can hardly be a lesson learned and used to avoid further accident.

Besides, a parked vehicle, with any conventional safety sensing device against burglary in order to save the vehicle from being stolen, normally gives an alarm or shuts down the engine upon sensing any impact or vibration to the vehicle. However, it can not prevent nor record the ins and outs of the happening as well as any information concerning to the person who causes the disaster. As a result, it is difficult for the victims to ask satisfactory compensation because they can not get evidence powerful enough.

The present invention, to solve the mentioned problems, provides a device to monitor/assist the vehicle to drive or park safely, prevent vehicle from accident, and record the ins and outs of the occurrence concerning to the vehicle itself and what in the environment when an accident occurs. The record can later be retrieved, reconstructed into information and diagrams, and thus the factors causing the accident can be analysed since. One of the functions of the device which records the vehicle accident might be similar to the flight recorder (the black box); however, the vehicle driving status, the roadway conditions and the traffic regulations are quite different from those in the air. Consequently, the flight recorder can not be applied to vehicles. Also, people trust the flight recorder because of the interpretation and analysis of it from

experts: the recorder itself does not provide sufficient information to reconstruct the accident and help analyse the cause of the accident automatically.

The invention basically provides an accident warning-and-preventing device to monitor the driver, the vehicle and the environment on a safety consideration; remind the drivers of the vehicle and of the passing vehicles to be watchful against danger; and automatically adjust the vehicle to meet safety concerns.

The invention also provides an accident-recording device to record the safety related information during an accident occurs, so that, the record can be used later for investigation of the conditions of the driver, the vehicle and the environment.

This invention further provides a device to reconstruct the accident by interpreting the recorded information from said accident-recording device and displaying what happened via simulation.

This invention also provides an analysis device of the cause of an accident which can analyse the recorded accident information and identify the possible cause that can be used as a reference for the official judgment and in avoiding further similar accidents.

The other objectives and functions of this invention will be described in the following embodiments.

Briefly speaking, this invention is to install a monitoring/controlling/recording device in individual vehicle which is able to detect/monitor the operation status of the vehicle itself, the driving status and the environmental conditions (such as the position of other vehicles, the traffic lights, the weather conditions, etc.) and remind the

driver timely when it senses danger and automatically adjusts the vehicle to meet the safety considerations; when an accident occurs to the vehicle, this device will record the ins and outs of the occurrence; the recording device is protected by a shell and designed to save recorded information and keep it from counterfeit; this record, processed through calculation of a computer, will be reconstructed, and displayed truthfully with animation diagram through a display unit; the recorded accident information can be analysed and judged through an analysing device based on pre-stored information such as knowledge, laws and regulations; a transceiver, installed in the monitoring device, transmits the accident information to the vehicles nearby and receives notice of accident information from other vehicles to avoid a series of collision. When a vehicle parks, this invention monitors the safety conditions of the vehicle, gives alarms or starts the control functions when senses danger which include sending warnings against bumping or burgling, recording the accident (such as image and data of the accident), starts the engine and charges battery automatically, etc..

The structures and functions of this invention will be described with embodiments in detail.

FIG. 1 is a block diagram of an embodiment of the invention.

FIG. 2 is a schematic diagram illustrating the obstacle sensors and cameras installed for the detection/measurement of obstacles outside the vehicle of the invention.

FIG. 3 is a flowchart of the invention describing the functions of monitoring/controlling/recording of the driving vehicle.

FIG. 4 is a block diagram of the invention showing composition

and operation of a module for protecting a parked vehicle.

FIG. 5 and FIG. 6 are flowcharts of the invention illustrating the procedures of how the functions of protecting the parked vehicle are executed.

FIG. 7 is a block diagram of the invention showing composition and operation of a reconstruction and analysis device of the invention.

FIG. 1 is a block diagram of an embodiment of the invention. There are several sets of sensing devices, 20, 22, 24 which consist respectively of a group of sensors installed in proper positions of a vehicle. Most of the devices have been installed before a vehicle leaves the factory. These sensors are used to monitor various conditions of the vehicle, such as operational conditions, driving conditions, and environmental conditions. The sensed values will then be sent, by means of a signal interface 21, to a microcomputer 1 which executes a series of related monitoring and controlling processes.

The sensors 20 for vehicle operational conditions consist of a starter sensor 201 to sense the operational position of the starter (to sense if there is a key inserted and which position it is); a steeringwheel sensor 202 to measure the turning angle of the steeringwheel; an accelerator pedal sensor 203 to sense the operational position of the accelerator pedal; a clutch pedal sensor 204 (vehicle with automatic transmission does not need it) to sense the operational position of the clutch pedal; a gear lever sensor 205 to sense the operational position of the gear; a brake pedal sensor 206 to sense the operational position of the brake pedal; a hand brake lever sensor 207 to sense the operational position of the hand brake lever; a horn sensor 208 to sense the status of the horn; lamp sensors 209

to sense on/off status of each lamp; a safety belt sensor 210 to sense if the belt has been buckled up; a door sensor 211 and a window sensor 212 to sense if the doors or windows are closed; a wiper sensor 213, a defroster sensor 214, a cruise control sensor 215 for sensing whether a cruise function is in use, and other appliance sensors 216 for sensing whether other appliance such as air conditioner or tape recorder is in use.

The sensors for vehicle driving conditions 22 comprise an engine revolution sensor 221 to sense the revolution of the engine; a direction sensor 222 and a speedometer sensor 223 to sense the driving direction and speed of the driving vehicle; a cooling water sensor 224 and a fan sensor 225 to sense respectively the level, temperature of cooling water, and rotation of the fan; an engine oil sensor 226 and a brake fluid sensor 227 to sense the oil level and pressure of the engine oil and brake oil; a fuel gauge sensor 228 to sense the quantity of the fuel; a battery sensor 229 to sense the condition of the battery; an accelerometer sensor 230 to sense accelerations of the vehicle in three axes and three directions (front-and-rear, right-and-left, up-and-down); and a sound pick-up 231 to sense the sound during the vehicle collision.

The sensors for environmental conditions 24 comprises of a light sensor 241 to sense the direction and intensity of light coming from outside (such as sunbeam and lights from the coming vehicles); temperature sensors 242, humidity sensors 243 and pressure sensors 244 to sense temperature, humidity, and pressure of cabin/ambient of the vehicle respectively; a rain/snow sensor 245 and a wind speed/direction sensor 246; a visibility sensor 247 to sense the visibility (the density of fog and smoke); a road slope sensor 248 to sense the ups and downs of the

road surface; a road slip sensor 249 to sense the status of the road surface (such as to be frozen, sandy, rocky or wet) which may cause the wheels of a vehicle to slip; obstacle sensors 250 to sense the position and distance of obstacles (may be other vehicles or obstacle), still or movable, around the vehicle; a traffic lane sensor 251; a vehicle location indicator 252; a traffic light sensor 253; and an electronic camera 254 to take pictures outside the vehicle.

The installation and functions of the obstacle sensor 250 and the electronic camera 254 will be described in FIG. 2. The road slip sensor 249 detects the slip based on the change of revolution difference between driving and driven wheels; the traffic lane sensor 251 identifies the traffic lane based on marks on the roadway from pictures taken by the electronic camera 254, or on detecting/measuring the passing vehicles in both sides from data of the obstacle sensor 250 together with the situations of the vehicles provided by the vehicle location indicator 252; the vehicle location indicator 252 and the traffic light sensor 253 can obtain the required information from a vehicle navigation system; the other sensors can be obtained from the existed vehicle devices or from adding some devices such as a potentiometer, a micro-switch, etc., or from any existed measuring technology or equipments, these can be accomplished by skilled persons and will not be described in detail herein.

Microcomputer 1, based on the above mentioned sensors, monitors and controls a series of operations which include a driving recording module M1 and a parking protection module M2; wherein, the procedures will be described from FIG. 3 to FIG. 5. In addition, a real time clock 26 provides time information (year, month, day, hour, minute and

second) to microcomputer 1: a receiver 3 receives information of traffic conditions or remote control signals sending out from a transceiver 19 from other vehicles. Each value sensed from mentioned sensors will be processed by microcomputer 1. The microcomputer 1 then generate respective signal output to indicators 4, actuators 5, a transmitter 6 and a permanent recorder 7. The indicators 4 consists of a display and an alarm which can notify the driver or the others of the safety information or related instruction by lamplight, sound or illustration, etc.; the actuators 5 include various actuating devices such as a brake actuator, a lamp controller, etc. to assist the driver's operations; the transmitter 6 will send accident information to the vehicle owner (when parked) or to other vehicles (when driving) whenever the microcomputer 1 acknowledges of safety concerns.

Most of all, the microcomputer 1 has a temporary register 17 to store and update all signals from the operational condition sensors 20, the driving condition sensors 22 and the environmental conditions sensors 24; once the accident occurs, the signals will be sent to a permanent recorder 7 (such as a PROM). The permanent recorder 7 has a protective shell (which includes fire-proof, water-proof, magnet-proof, bump-proof, and electric-shock-proof, etc.) and anti-counterfeited data (which may include vehicle license number, engine ID, vehicle model, etc.) that can later be retrieved directly or through a memory card 8 to a reconstruction/analysis device 9 to display/reconstruct the accident and provide causation as reference to assist official judgment. The operations between the microcomputer 1 and mentioned input and output devices will be described in detail later.

FIG. 2 is a diagram illustrating the installation of obstacle sensors 250 and cameras 254 of an embodiment of the invention. The embodiment obstacle sensors 250 are several sensor units 250a for sensing ultrasonic wave, laser, infrared rays or temperature at proper positions in each span area A around the body of vehicle V. These sensors 250a scan the obstacles outside the vehicle to obtain the environmental conditions along with the movement of the vehicle V. The embodiment of electronic camera 254 are several solid state image-pickup units 254b (each unit consists of proper lenses, metal oxide semiconductors MOS or charge-coupled devices CCD, etc.) installed at proper positions around the body of vehicle V to take pictures of the outside: wherein, the optimum areas B for taking pictures will cover the whole surroundings. The image pickup units 254b can share an unshown actuator, and be controlled by the microcomputer 1 to take pictures in turns and store signals temporarily; till an accident occurs, the pictures together with sensed data from obstacle sensors 250 and accelerometer sensor 230 will be transferred to permanent recorder 7.

FIG. 3 is a flowchart of the invention describing the functions of monitoring/controlling/recording of the driving vehicle; that is, the operational procedure of the driving recording module MI in micro computer 1.

The driving recording procedure S10 begins as the vehicle starts. Firstly, it performs the system testing S11. (The microcomputer 1 outputs the test signals and checks the feedback to certify if the microcomputer itself and each input, output device is all in good condition.) When the system gets a slight damage, it will send warnings

to the driver, instruct of the needed maintenance (S13) and actuate the driving monitoring process (S12): if the damage is serious, such as malfunction of several or some important sensors, the system not only sends the corresponding warnings but also limits the driving mileage to urge a prompt maintenance(S14). After the driver punches an unshown keyboard to acknowledge the situation and starts driving (S15), the warnings will vanish, the driving monitoring process (S12, S16) starts and the restricted mileage (S17) starts counting down till the restricted mileage is reached (S18); then the engine is shut down (S19, S20).

The driving monitoring process S12 reads each sensed value orderly. The sensing frequency of each sensor is based on its variation rate or importance, such as per meter's driving distance or per 20 ms. These values, together with time signals, are stored in the temporary register 17 (FIG. 1) where stores the latest (e.g. 20 seconds) record (S22). Some of the sensed values, such as from the accelerometer sensor 230, the obstacle sensor 250 and the sound pick-up 231, indicate impact and abnormal movement of the vehicle which can be used to judge whether an accident occurs. When an accident is identified, microcomputer 1 (FIG. 1) sends, through the transmitter 6, the accident signals to receivers 3 of each nearby vehicle, and triggers their indicators 4 to release warning signals to alert the drivers. Meanwhile, the record stored in the temporary register 17 will be compressed and write to permanent recorder 7 (S26).

During the happening, each sensed value will be stored in the temporary register 17 consecutively (S27, S28). Upon a certain time (such as 20 seconds), till each sensed value remain unchanged, the records

in the temporary register 17 will then be compressed and written to permanent recorder 7 for a complete accident recording (S29, S30); and loops back to system testing process (S11) till the engine of the vehicle is shut down. Besides, at monitoring process, if the microcomputer 1 monitors any value sensed abnormal or having a dangerous tendency (S23) (such as the vehicle is going to be hit, collided or capsized; brake malfunctions; the engine is overheated or out of order; the door of the vehicle is not locked; the lamp is out, or still off while it is dark or foggy, etc.); then it sends warning/control signals to indicators 4 and specific actuators 5. The driver is thus warned of the danger and can take proper action against it, or the status of the vehicle will be adjusted and controlled automatically, such as to reduce speed with a brake, flash the light, sound a horn to alert the outsiders, or lock the door automatically, or turn on the lamp automatically (S24), to enhance the driving safety.

The present invention not only executes the mentioned driving monitoring and recording function, but also has function of safety protection while parked against burglary, collision, and can record the damage. FIG. 4, 5 and 6 show the function of parking protection i.e., the block diagram of parking protection module M2 in the microcomputer 1 shown in FIG. 1.

The parking protection module M2 comprises: module on/off procedures S50 and S70; system check procedure S51, safety protection control procedures S54 - S65, automatic charge control procedure S80, related warning signal interface 14, control signal interface 15, and temporary register 17. Module on/off procedure S50 can be remotely controlled outside the vehicle by a driver's transceiver 19 to the receiver

3; or, the parking protection procedure can be on/off by keying secret codes inside or outside the vehicle through an unshown keyboard.

Refers to both of the FIG. 5 and FIG. 6 for the protection flow. At the beginning (S50), the system is first checked (S51) to certify whether all the related input and output devices are functional, and whether the vehicle has been safely parked. That is, each value sensed from starter sensor 201, gear lever sensor 205, hand brake lever sensor 207, lamp sensor 209, door sensor 211, window sensor 212, windshield wiper sensor 213, defroster sensor 214 and other appliance sensors 216 (FIG. 4) is checked and confirms to be in off condition. If any of the sensed value is abnormal, then a display 41 and alarm 42 will send warning signals, display the abnormal items and the respective restrictions (S52). For example, a certain sensor is out of order, then that protection can not be executed. The user can execute the monitor and protection procedure after certifying or correcting the abnormal situation (S53).

To save power consumption, the system can, in ordinary time, actuate in lower frequency and senses related values (S54) such as data from accelerometer sensor 230, sound pick-up 231, light sensor 241, cabin/ambient temperature sensor 242, obstacle sensor 250, electronic camera 254, real time clock 26, etc.; the sensed values will be stored in the temporary register 17 and the oldest record will be deleted (S56); microcomputer 1 will then judge whether an incident occurs from the sensed values (S55). For example, whether the body of the vehicle is collided, damaged, broken into or the engine is turned on illegally. While happening, microcomputer 1 will send out incident signals through warning signal interface 14, and try to reach the transceiver 19 of the

owner of the vehicle through the transmitter 6; or give an alarm through an alarm 42 to frighten the burglar; or through the control signal interface 15, actuate a lock actuator 53 to lock the doors of the vehicle, or through a fuel/power cut-off actuator 54 to shut down the engine (S59); meanwhile, the record in the temporary register 17 will be compressed and then write to the permanent recorder 7 (S60).

Upon the incident, all sensors will be actuated with higher frequency and values sensed will be stored in temporary register 17 (S61, S62). Once the sensed values remain unchanged for a period, the records in the temporary register 17 will be compressed again and written to permanent recorder 7 for a complete record of the ins and outs of the occurrence (S63, S64). Then, microcomputer 1 will summarise the incident (time, accident characteristics and location, etc.) and store it to another unshown temporary register (S65); then, the sensing work back again in lower frequency (S54) till the protection module is terminated (S70) by the owner of the vehicle. At terminating, a display 41 will first outline the information of the incident to the owner to certify and deal with; and then ends the protection procedure (S71, S72, S73).

Besides, while executing the protection, microcomputer 1 keeps monitoring if there is any abnormal value or dangerous trend (S57); for example, if the vehicle is estimated to be bumped by other speedy vehicle, the temperature inside the vehicle is overheated, or the window is frozen, the control signal interface 15 will output corresponding control signal to the specific actuator to protect the vehicle; such as to actuate a warning light actuator 52 to alert the driver of the coming vehicle, or to actuate an unshown ventilation or defrost device.

Moreover, when the power of the power supply 10 is insufficient (detected by the battery sensor 229)(FIG. 4), however, the volume of fuel is sufficient (detected by the fuel gauge sensor 228), the system will execute automatic charge control procedure (S80) which, by means of a control signal interface 15, to output control signals to actuate an engine starter 55 and an accelerator actuator 56, and, based on value sensed from engine revolution sensor 221, to get the optimum engine revolution to charge. Also, the automatic charge control monitors values sensed from cooling water sensor 224, fan sensor 225, engine oil sensor 226, fuel gauge sensor 228 and battery sensor 229 to have a safely engine rotation till the power supply 10 is charged to an appropriate degree. To avoid the waste gas generated indoors while the engine rotates, the automatic charge procedure will not be executed indoor. This is accomplished and judged by Microcomputer 1 through values sensed from obstacle sensors 250.

Since, at the present invention, information wrote at permanent recorder 7 is value compressed from register. These sensed values comprise only bit data - binaries (1 or 0). And as to values from the sound pick-up 231 and electronic camera 254 which have a lot more binaries, the invention can record information during critical period of time only. Therefore, a permanent recorder 7 equipped with appropriate capacity will satisfy the requirement to record several incidents and vehicle statuses during the vehicle's life time. As a result, the record will exist with the vehicle, and can be used for investigation purpose, for example, as a reference to check the safety of the vehicle and its driving status. To insure the truth and completeness of these records, the major

device of the invention. microcomputer 1 and permanent recorder 7 are designed not to be dismantled, damaged and modified. When it is installed or replaced, it can be examined or registered through an authorized organisation for overall control certification. What recorded in the permanent recorder 7 is attributed as read only and can not be modified. (microcomputer 1 has an unshown record output interface which can output information to a memory card 8.) The interpretation will be proceed through a specific reconstruction/analysis device 9.

FIG. 7 is a composition and operation procedure of reconstruction/analysis device 9 of the embodiment. It mainly comprises a card reader 90, a computer 91, an input unit for display control 92, a display 93 and a data base 94, etc. The reconstruction/analysis device 9 can judge a single or several vehicles by reading one or more than one related records from concerning vehicles. For example, as shown in FIG. 6. a card reader 90, through the control of microcomputer 1, searches, and reads the basic information of each vehicle from permanent recorder 7A, 7B through corresponding memory card 8A, 8B, and check the belonged vehicle license number and time (S911). After certified, the card reader 90 reads and retrieves the whole required information and stores it to the unshown memory unit (S912) in the computer 91 for further process. The operation of computer 91 actually contains two procedures, reconstruction display procedure M3 and analysis procedure M4, which can be operated independently.

The reconstruction display procedure M3 first decompresses, reconstructs the vehicle information to original sensed values and calculates the correlations between sensed values, for example, the

accelerometer value can be used to calculate the center of gravity of the vehicle and the accelerating velocity of its movement and revolution, and then compared that with the related data (S913); image and sound data can be processed to original state (S914); the required information in reconstructing a vehicle accident, such as the size of the vehicle and the related vehicles, related positions, directions of movement, speeds, locations and the environmental conditions, can be reconstructed in a series of animations according to time sequence, and stored at a recorder (S915); and then, based on each preset reconstruction module, the viewer can select it through an input unit for display control 92, and control/interpret and display the ins and outs of the accident on a display 93 with sketch, sound, image (S916). For example, it will first display the time of the accident, how many vehicles involved, the vehicle license numbers, the vehicles' types and the location of the accident, and then reconstruct the accident; on the display, it also shows time and distance of the accident involves; the animation is displayed by normal speed; it can be controlled to entirely or partially replay the accident at any speed; and it can also be modulated to enlarge, condense, lock, advance and retreat. The animation technique can be obtained by the existed computer software technology.

The analysis procedure M4 adapts information stored on the data base 94, (which comprises vehicle function theory 941, driving operation rule 942, traffic regulation 943, precedents 944, etc.) to assist and help judging the cause and responsibility of the accident. First, it fetches the sensed values which are related to the operations of the vehicle (S913), and checks whether that is functioning, then refers to vehicle function

theory to analyse the malfunction (S917): for example, when a brake pedal is pressed, while the pressure of the brake oil does not increase and the driving speed does not decrease either, it can be judged that the brake is out of order. Moreover, by fetching data related to operation of the driving and refers that with the driving operation rule 942 and the traffic regulation 943, inappropriate driving is analysed (S918); for example, the vehicle is sensed to be speedy, or the vehicle changes lane without notifying others with directional lamp, etc. Later, the judgment of the cause of the accident (S919) will be identified based on the result of analysis and the time sequence. That is, the related cause and its correlation will be itemised which enables people to certify. Finally, all the results are compared with the existed precedents 944 which provides information of responsibility attribution and reaches conclusion (S920). How to build the regulation data base 94 and how to operate it can be obtained by the existed specific system of computer technology.

The above mentioned reconstruction and analysis results of each stage can be output through display 93. This would be a fair reference to those who get involved and those who should be responsible (individual, vehicle manufacturer, maintenance shop, public traffic facilities, etc.). The insurance companies can also establish a reasonable premium of an insurance policy thereafter. Even the driver who hit and run can not evade discovery because of the recorded evidence, and this will enforce the driver to be more careful. Besides, the course of the vehicle accident can be a valuable teaching material for the driving school. Since the accident recording device in the vehicle monitors the safety condition of the vehicle itself, it will give an alarm and record the course of the

accident when an accident occurs. and the vehicles can be removed instantly to keep the traffic flow without obstruction.

The above mentioned embodiments, diagrams and description are only to explain the special features of the present invention and its construction. Any modification based on the spirit of this invention is included in the extent of the appended claims.

CLAIMS

1. An accident prevention and recording device, capable of monitoring the operational, driving conditions of individual vehicle and its environmental conditions; warning of and preventing an accident while the vehicle is driven; recording said operational, driving conditions of the vehicle and said environmental conditions while an accident occurs and monitoring the safety of the vehicle while parking, comprising:

sensing means, located at proper positions of the vehicle, for sensing said operational conditions, driving conditions of the vehicle and said environmental conditions and generating values respectively;

computing means, for monitoring, analysing with proper frequency each said values from said sensing means, and generating corresponding warning signals and control signals;

display and actuators, for providing warning and control to said vehicle according to said warning signals and control signals and improving safety;

a temporary register, controlled by said computing means, for storing and updating said values; and

a permanent recorder, controlled by said computing means, for storing values transferred from said temporary register while an accident occurs, said recorder is read-only and protected with a shell against damage and counterfeiting.

2. A device according to claim 1, wherein said sensing means comprises a real time clock, and at least most of:

means for sensing operational position of starter;

means for measuring turning angle of steeringwheel;

means for sensing operational position of accelerator pedal;

means for sensing operational position of clutch pedal;

means for sensing operational position of gear;

means for sensing operational position of brake pedal;

means for sensing operational position of hand brake lever;

means for sensing status of horn;

means for sensing on/off status of each lamp;

means for sensing if safety belt has been buckled up;

means for sensing if doors are closed;

means for sensing if windows are closed;

means for sensing operational status of windshield wiper;

means for sensing if defroster is in use;

means for sensing if cruise function is in use;

means for sensing if other appliances such as air conditioner, radio or tape recorder are in use;

means for sensing revolution of engine;

means for sensing driving direction of said vehicle;

means for sensing driving speed of said vehicle;

means for sensing level and temperature of cooling water;

means for sensing if fan is in use;

means for sensing level and pressure of engine oil;

means for sensing level and pressure of brake fluid;

means for sensing quantity of fuel;

means for sensing condition of battery;

means for sensing acceleration in three axes and directions including front-and-rear, right-and-left and up-and-down;

means for picking up sound when said vehicle is collided:

means for sensing direction and intensity of light:

means for sensing air temperature:

means for sensing air humidity;

means for sensing air pressure;

means for sensing whether it is raining or snowy;

means for sensing speed and direction of wind;

means for sensing visibility;

means for sensing ups and downs of road surface;

means for sensing road slip conditions;

means for sensing position and distance of obstacles:

means for sensing traffic lanes in roadway;

means for indicating current location of said vehicle;

means for sensing traffic light in front of said vehicle; and

means for taking pictures outside said vehicle.

3. A device according to claim 1, further comprising means for retrieving recorded values in said permanent recorder of at least a vehicle to a reconstruction device, said reconstruction device comprises mainly a computer for executing procedures of:

retrieving said recorded values from said permanent recorder of each vehicle, certifying accuracy of said retrieved values;

reconstructing said values to original sensed values, calculating correlations between said sensed values;

generating, based on said sensed values, a series of animation of said accident comprising size of vehicles, respective positions, directions of movement, speeds of each vehicle, location and related environmental

conditions; and

providing selections, to viewers, of data, diagram, sound, image, and animation in display of accident reconstruction.

4. A device according to claim 1, further comprising means for retrieving recorded values in said permanent recorder of at least a vehicle to an analysis devices, said analysis device mainly comprises a computer, for executing procedures of:

retrieving said recorded values from said permanent recorder of each vehicle, certifying accuracy of said retrieved values;

reconstructing said values to original sensed values, calculating correlations between said values;

fetching values related to operational conditions of vehicle itself, checking if there is any malfunction, analysing these with a pre-stored vehicle-function-theory database to check whether any abnormal function occurred;

fetching values related to driving conditions, analysing these with a pre-stored operation-rule database and a traffic-regulation database to check whether any inappropriate driving conditions occurred;

judging and analysing possible cause of said accident based on said database analysis; and

providing output of possible cause and responsibility of said accident through comparing cause with a pre-stored precedents database.

5. An accident prevention, recording, retrieving and analysis device for vehicle, substantially as hereinbefore described with reference to the drawings.

Patents Act 1977
Examiner's report to the Comptroller under Section 17 (The Search Report)

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Relevant Technical fields

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Search Examiner
D L SUMMERHAYES

Databases (see over)

(i) UK Patent Office

(ii) ONLINE DATABASE: WPI

Date of Search
16 SEPTEMBER 1992

Documents considered relevant following a search in respect of claims 1-5

Category (see over)	Identity of document and relevant passages	Relevant to claim(s)
Y	GB 2224358 A (LAWRENCE) see whole document	1 at least
Y	GB 2207401 A (LIN) see whole document	" "
Y	GB 2081484 A (HONDA) see whole document	" "
Y	EP 0462464 A2 (KIENZLE) see whole document	" "
Y	WO 88/09023 A1 (SZABO) see particularly the abstract	" "
Y	WO 86/04869 A1 (FAIL SAFE) see whole document	" "
Y	US 4638289 (ZOTTNIK) see particularly column 5 lines 22-28	" "
Y	US 4281354 (CONTE) see whole document	" "
Y	US 3781824 (CALATI) see particularly column 1 lines 52-59	" "

Category	Identity of document and relevant passages	Relevant to claim(s)

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